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PHYTOPATHOLOGY

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HOST PLANTS OF BACTERIUM TABACUM

JAMES JOHNSON, C. M. SLAGG AND H. F. MURWIN[1]

WITH PLATES V AND VI

One of the most promising methods for the control of the wildfire disease of tobacco caused by *Bacterium tabacum* Wolf and Foster, seems to lie in the prevention of seed bed infestation. This involves problems of over-wintering, upon which investigations are in progress in this laboratory. In this connection we were led to investigate other probable host plants of the wildfire organism, since it is conceivable that infested material may enter the seed bed from such sources, either through actual over-wintering in perennials or through dried infected materials being transferred to the seed beds.

The results of the study of the possible host plants of the wildfire organism are believed to be of sufficient interest to warrant publication. We are not prepared to say, however, that any of the plants which we have found susceptible to attack by *B. tabacum* are of practical importance in relation to over-wintering and control of the disease in question.

EARLIER OBSERVATIONS

Wolf and Foster (3) first described the wildfire disease of tobacco, and at that time reported apparent infection on cow-peas, but that infection was not secured on pepper and jimson weed in their trials. Wolf and Moss (4) later reported unsuccessful attempts to inoculate the Irish potato, tomato, pepper, egg plant, jimson weed, and horse nettle. Similar results were reported by Clinton and McCormick (2) on tomato, jimson weed, poke-weed, pepper and egg plants, although in the case of the two latter plants the results of inoculations were doubtful.

Chapman and Anderson (1), however, secured infection on petunia, egg plant and poke-weed, and report finding wildfire on tomato plants growing in an infected tobacco seed bed.

[1] Wisconsin Agricultural Experiment Station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture. Published with the permission of the Director of the Wisconsin Experiment Station.

EXPERIMENTAL METHODS

Our early experience with the wildfire organism indicated that at times our cultures of *B. tabacum* lost all or part of their pathogenicity, in some cases in a comparatively short period. In our inoculation work, therefore, we made certain that a good pathogenic culture was used as judged by the virulence of attack on tobacco plants inoculated at the same time.

The plants inoculated were usually grown in pots in the greenhouse, and were in most cases transferred to a damp chamber for one to two days after inoculation. Some judgment was used in making the inoculations at a stage of growth when the foliage seemed most likely to be susceptible. This was usually during a rapid stage of growth or before the plants were in any way stunted by unfavorable conditions.

Wildfire inoculations without wounding are always less likely to give infection than when wounds are present. With a good culture and reasonably favorable environmental conditions, however, excellent infection may often be obtained without wounding. In the host plant study we have used both methods. Positive results were more often secured by inoculation with needle punctures on which a droplet of water suspension of the wildfire organism was used. We interpret infection secured by this means as an indication of parasitism, recognizing that the degree of susceptibility may be considerably less, however, than where infection can be readily secured without wounding the epidermis.

In cases where infections appeared questionable on first trial, the inoculations were usually repeated. Duplicate sets of inoculations were always made and usually fifty or more wounds were produced in each case.

EXPERIMENTAL RESULTS

The details of the data concerning the extent of infection or relative susceptibility of the hosts, and the type of lesions produced in the wound and atomizer inoculations do not seem to be of sufficient importance to warrant publication at this time. It is deemed sufficient, therefore, to merely list the plants which we have found susceptible to attack by the wildfire organism. We have for the most part grouped these in the botanical families or genera to which they belong. If symptoms of the disease occurred with wound inoculations, even though comparatively slight, the plants are included in the list. Although infection was secured, in most cases, without wounding, failure to secure it in this manner was not regarded as sufficient cause for removal of the plants concerned from the host list, established by the wound inoculations.

SOLANACEAE. It was hoped that some of the various species or distinct varieties of Nicotiana, to which tobacco belongs, might prove immune to attack by the wildfire organism, and possibly form the basis for the breeding of a resistant commercial type, since there has been no evidence that any of the ordinary varieties of *N. tabacum* show resistant qualities. All of the species and varieties tested, however, proved to be quite uniformly susceptible to wound inoculations, although fairly marked differences occurred when the organism was applied by the atomizer only. Further study would be necessary, however, to establish any actual variation in this respect.

The following species were infected: *N. glauca, N. rustica, N. acuminata, N. Bigeloweii, N. suaveolens, N. repanda, N. paniculata, N. alata grandiflora, N. sylvestris, N. langsdorffii, N. glutinosa.* In addition the following types probably most correctly classed as varieties of *N. tabacum* were infected: *angustifolia, atropurpureum, calyciflora, laterrima, macrophylla, chinensis, trigonophylla, campanulata.*

Infection was also secured upon pepper (*Capsicum annuum*), egg plant (*Solanum melongena*), tomato (*Lycopersicum esculentum*), potato (*Solanum tuberosum*), ground cherry (*Physalis grandiflora*), black nightshade (*Solanum nigrum*) and jimson weed (*Datura stramonium*).

While good infection could be secured on all these plants with or without wounding, this family is not on the whole apparently any more susceptible to the wildfire organism than are certain other families. The pepper and egg plant were especially susceptible. As a genus, however, it is believed that the Nicotianas are more likely to become attacked than are any other plants in this or other families.

CUCURBITACEAE. Heavy infection was secured upon muskmelon, (*Cucumis melo*), watermelon (*Citrullus vulgaris*), pumpkin (*Cucurbita pepo*) and cucumber (*Cucumis sativa*). No other species of this family were tried.

This family appears to be especially susceptible to attack, however, probably ranking with the Solanaceous family in this respect. The watermelon and muskmelon plants were practically killed by the wildfire disease, both in the wounded and unwounded series.

LEGUMINOSEAE. Infection was secured upon bean (*Phaseolus vulgaris*), garden and field pea (*Pisum sativum*), peanut (*Arachis hypogoea*), soy bean (*Glycine hispida*), vetch (*Vicia villosa*), cowpea (*Vigna sinensis*), red clover (*Trifolium pratense*), white clover (*Trifolium repens*), alsike clover (*Trifolium hybridium*), alfalfa (*Medicago sativa*). Biennial white blossom sweet clover (*Melilotus alba*), biennial yellow blossom sweet

clover (*Melilotus officinalis*) and Hubam or annual sweet clover (*Melilotus sp.*). No particularly marked susceptibility was noted in this group of plants, although most of them could be infected without wounding the tissues. The bean and peanut produced particularly typical symptoms of wildfire.

GRAMINEAE. Infection was secured upon the following species: wheat (*Triticum sativum*), barley (*Hordeum vulgare*), rye (*Secale cereale*), corn (*Zea mays*), oats (*Avena sativa*), timothy (*Phleum pratense*), quack grass (*Agropyrum repens*), witch grass (*Panicum capillare*), orchard grass (*Dactylis glomerata*), sudan grass (*Andropogon sorghum*) and yellow foxtail (*Setaria glauca*).

The susceptibility of this family of plants appears to be relatively low. Typical halos were secured by wound inoculations and considerable infection from atomizer inoculations, but on the whole the infections were not abundant enough to endanger the plants.

CRUCIFERAE. The following representatives of this family were infected: cabbage (*Brassica oleracea*), turnip (*Brassica rapa*), rutabaga (*Brassica campestris*), radish (*Raphanus sativus*), rape (*Brassica napus*), mustard (*Brassica alba*) and Shepards purse (*Capsella Bursa-pastoris*).

These plants proved quite susceptible on the whole, mustard, for instance, becoming heavily infected from atomizer inoculation. On the others typical and large halos were usually produced by wound inoculation. This group appears more susceptible than the grass family, and probably ranks with the legumes in this respect.

COMPOSITAE. Eight species from this family were inoculated and of these six became infected. These were: sunflower (*Helianthus annuus*), dandelion (*Taraxacum officinale*), ragweed (*Ambrosia artemisiifolia*), sow thistle (*Sonchus oleraceus*), Canada thistle (*Cirsium arvense*) and prickly lettuce (*Lactuca scariola*). Garden lettuce (*Lactuca sativa*) and cineraria (*Senecio cruentus*) could not be infected in our trials.

With the exception of the Canada thistle the plants listed as infected proved to be quite susceptible to both wound and atomizer inoculations.

POLYGONACEAE. Six species were inoculated and infection was secured upon five, namely: Buckwheat (*Fagopyrum esculentum*), ladies-thumb (*Polygonum persicaria*), bind-weed (*Polygonum convolvulus*), knot-weed (*Polygonum erectum*) and red dock (*Rumex acetosella*).

Infection was not secured upon curled dock (*Rumex crispus*). Buckwheat and ladies-thumb were quite susceptible, especially to wound inoculations, but red dock only slightly so.

CHENOPODIACEAE. Both the garden and sugar beet (*Beta vulgaris*)

were infected, as was spinach (*Spinacea oleracea*) and lambs-quarter (*Chenopodium album*).

MALVACEAE. Cotton (*Gossypium herbaceum*) and mallow (*Malva rotundifolia*) gave good infection both on wounded and unwounded foliage.

LABIATAE. Three representatives of this family were inoculated and infected, namely: catnip (*Nepeta cataria*), coleus (*Coleus blumei*) and salvia (*Salvia splendens*). The infection was marked on catnip only.

UMBELLIFERAE. Carrot (*Daucus carota*) and parsnip (*Pastinaca sativa*) could only be infected with considerable difficulty.

MISCELLANEOUS SPECIES. Infection was also secured on single species from thirteen other families. These are: chickweed (*Stellaria media*), plantain (*Plantago major*), purslane (*Portulaca oleracea*), evening primrose (*Oenothera biennis*), pig-weed (*Amaranthus retroflexus*), poke-weed (*Phytolacca decandra*), tulip (*Tulipa sp.*), barberry (*Berberis vulgaris*), mullein (*Verbascum thapsus*), bryophyllum (*Bryophyllum sp.*), jewel-weed (Impatiens), rose (*Rosa spp.*) and maple (seedling) (*Acer saccharinum*).

DISCUSSION OF RESULTS

We have by no means made an attempt to cover the host range of *Bacterium tabacum*. The plants inoculated were selected primarily as representing crop plants or common weeds, which were most likely to be concerned in over-wintering. They represent, therefore, a somewhat random selection from among the botanical families of plants. Fully ninety per cent of the plants with which we worked gave more or less infection upon inoculation. The host list could, therefore, probably be greatly increased by further trials.

No cases of marked outbreak of the wildfire disease on other crops than tobacco have come to our attention. It is not unlikely, however, that such may occur on some crops, judging by our comparative inoculations on tobacco. Natural field infection has been noted to occur on cowpeas by Wolf and Foster (3), on tomato by Chapman and Anderson (1), and on cucumber by one of us.

Our results cannot be accounted for on the basis of using any particular strain of *B. tabacum*. A large number of different strains have been used in our laboratory, and those used were selected practically at random, care being taken only to have vigorously pathogenic strains. Reference to our early notes shows that in October, 1918, we infected *Nicotiana glauca*, *N. rustica*, *Vigna sinensis*, *Secale cereale* and *Cucumis sativa* with a culture of *B. tabacum* secured from Wolf.

The ability of *B. tabacum* to attack such a wide range of plants seems to indicate unusual adaptation on the part of the parasite. On the other hand, it is believed that many of our plant parasites would behave in a more or less similar way when submitted to trial. The gradual adaptation of parasites to their hosts, and the outbreak of "new" diseases seems to be well illustrated in such studies. If wildfire is really a "new" disease of tobacco it is not difficult to believe that the parasite may have previously existed on some other host from which it has recently passed to the tobacco.

SUMMARY

1. *Bacterium tabacum* Wolf and Foster, the causal organism of the wildfire disease of tobacco, is capable of producing disease symptoms, more or less typical, on a wide variety of plants.

2. Infection has been secured upon twelve species of Nicotiana and seven other members of the Solanaceae. Four species of the Cucurbitaceae, thirteen of Leguminosae, eleven of the Gramineae, seven of the Cruciferae, six of the Compositae, five of the Polygonaceae, three of the Chenopodiaceae, three of the Labiatae, two of the Malvaceae, two of the Umbelliferae and single species of thirteen other families have been shown to be susceptible to attack.

3. The large majority of the plants inoculated were infected, and it is therefore believed that the host range of *B. tabacum* is very much larger than indicated by these results.

4. The inoculations were undertaken primarily to study possible sources of the overwintering of the wildfire organism. The results are published separately for the general interest they may have, and their probable bearing on theories of parasitic adaptation and the origin of disease.

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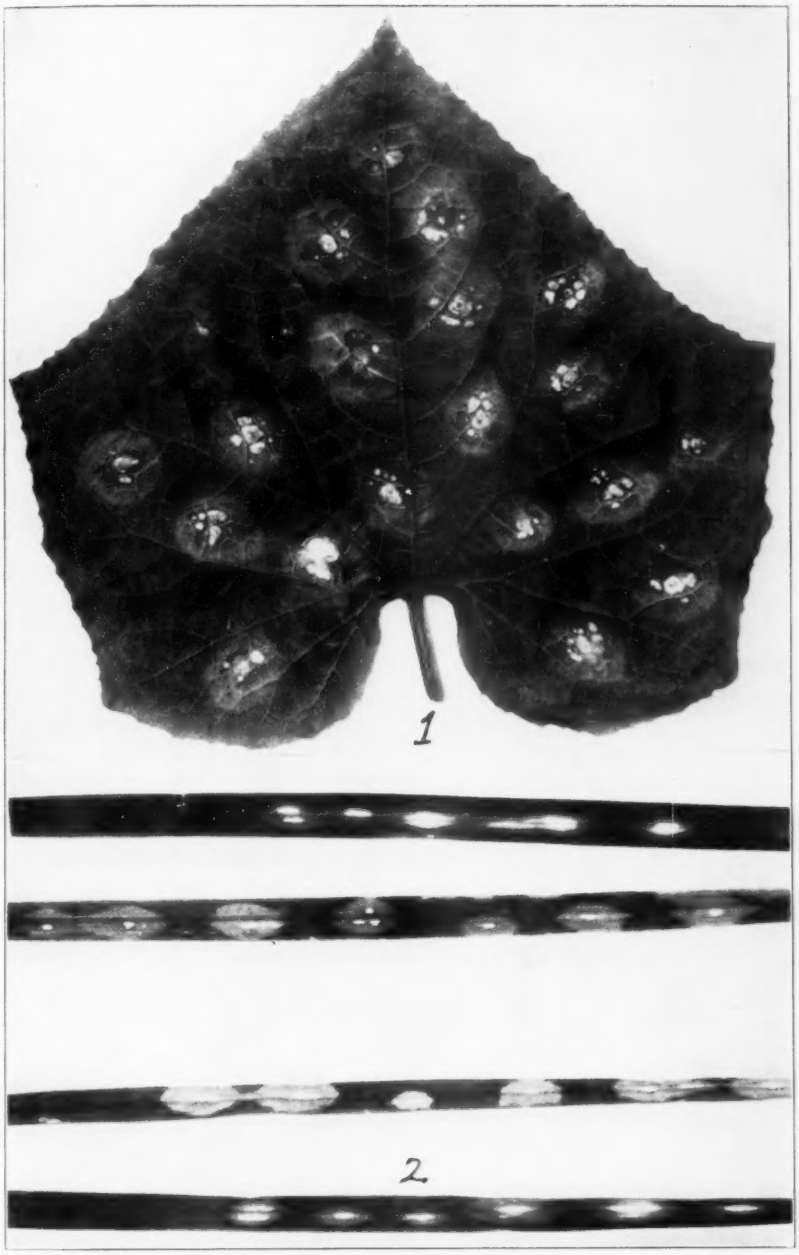

BACTERIUM TABACUM ON VARIOUS HOSTS.

FIG. 1. Cucumber leaf showing typical "wildfire" (*Bacterium tabacum*) infection following wound inoculations. FIG. 2. Leaf blades of timothy and quack grass showing halos produced following wound inoculations with *B. tabacum*.

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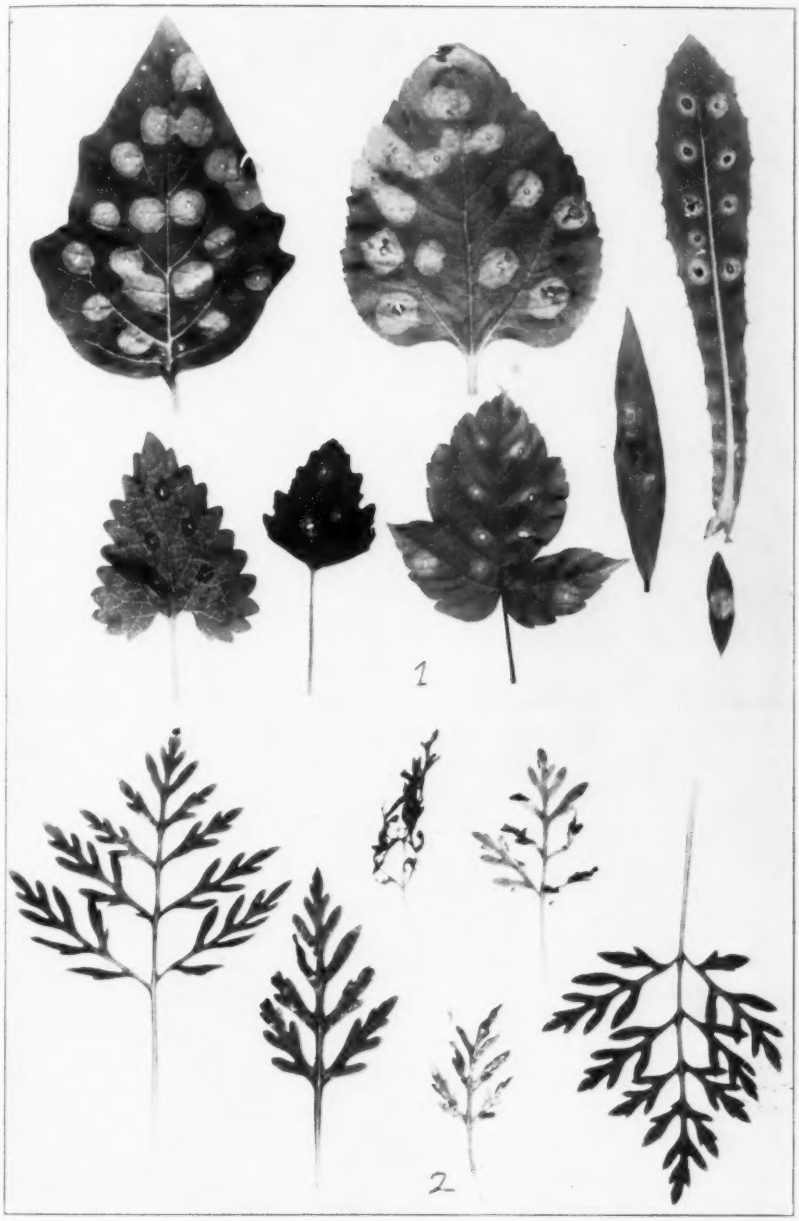

BACTERIUM TABACUM ON VARIOUS HOSTS.

FIG. 1. Leaves of poke-weed, sunflower, prickly lettuce, catnip, lambs-quarter, maple, ladies-thumb, and chick-weed infected with the wildfire organism by wound inoculations. FIG. 2. Stages of the wildfire disease on common ragweed following inoculation by atomizing suspension of organism on unwounded plant. Inverted leaf from control plant.

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TOBACCO WILDFIRE AND TOBACCO SEED TREATMENT

H. E. Thomas

With One Figure in the Text

Wildfire of tobacco was first recognized in New York State in July, 1922, on material from Chemung County. The disease had apparently been present in that county for at least one year previous to that date. The results of a limited number of field inspections have indicated that the disease is not as yet widely distributed in the state. Experience during the season of 1922 however left no doubt as to the severity of the disease where it has become established. This paper records some observations and experiments relating to the overwintering of *Bacterium tabacum* (Wolf and Foster) and more particularly to the treatment and handling of tobacco seed.

OVERWINTERING OF BACTERIUM TABACUM

A wide difference of opinion prevails in regard to the manner of overwintering of *Bacterium tabacum* (1), (2), (3), (5). In this connection an interesting observation was made in 1923 with reference to the seed as a carrier of the pathogene. A grower planted part of a bed with seed treated in corrosive sublimate and the remainder of the same bed with untreated seed. The bed was examined by the writer just before transplanting time and the plants from untreated seed were quite generally infected. In contrast no wildfire could be found on any of the plants from treated seed, except those adjacent to the junction line.

In the study of the overwintering of the organism in the field only one experiment, Clinton and McCormick (2), seems to have yielded positive evidence. The observations of Fromme and Wingard (3) and Anderson and Chapman (1) suggest that overwintering in the field is possible. The following experiment is of interest in this relation. On April 12, 1923, about 4 bushels of tobacco stems, roots and leaves were collected in a field which had grown a badly diseased crop in 1922. On April 19 this material was buried 1 to 3 inches deep in 4 trenches each 30 ft. long on the College Farm at Ithaca. Plants were started in the greenhouse on steamed soil from seed treated in corrosive sublimate. One plot (no. 1) was planted in rows directly over the buried stems on June 8. Plants from the same lot were set in a control plot (no. 2) about 350 feet distant in the same field. No wildfire could be found on the

transplants and no other tobacco fields were known within 20 miles of Ithaca. The midsummer season was unusually dry and frequent inspections failed to discover symptoms of wildfire in either plot until September 18 when 1 plant in plot 1 showed a few spots typical of wildfire. On September 25, 2 additional plants in the opposite end of the plot showed similar symptoms and by October 2, 13 of the 50 plants in this plot showed light to severe infection. Up to this last observation, no wildfire could be seen in plot 2.

SEED TREATMENT AND SEED GERMINATION

In the spring of 1923 a number of New York tobacco growers used for the first time the standard method of seed treatment,—mercuric chloride 1:1000 for 12 to 15 minutes. Most of these growers reported difficulty in germinating the treated seed and some failed to obtain any germination. The failure was too general to be attributed to faulty handling of the seed treatment. An inquiry brought out that these growers regularly practice germinating the seed in bulk in moist rotten wood, a woolen cloth or a discarded sock before it is sown upon the bed. This practice is believed to be necessary on account of the shortness of the growing season. In the warmer states where seed treatment has been used with excellent results, the seed is sown directly on the bed without previous germination.

Anderson and Chapman (1) report from Massachusetts a condition somewhat similar to that in New York State as regards the failure of germination in bulk of treated seed.[1] These authors believe that the failure to germinate is due to hardening of the seed coat after drying rather than to the chemical which is used in treatment. They obtained better germination of treated seed in bulk at relatively low temperatures and high moisture content.

The writer made several experiments in 1923 bearing on the various methods of seed treatment and germination. The seed used in these tests was of the Connecticut Havana Type and mostly of the 1922 crop. When mercuric chloride was used, unless otherwise stated, the treatment was for 15 minutes in a 1–1000 solution and the seed was washed for 10–20 minutes in tap water and dried before germinating. Aside from sowing on the soil two methods of germination were used corresponding to that used in developing the seed treatment method (4) and to the method of

[1] Since this was written the abstract of Johnson and Murwin has appeared in Phytopathology for January, 1924.

handling employed by our growers. In the former the seed was sown thinly on filter paper placed on moist sand in a glass dish, usually a petri dish. In the latter method the seed was tied in muslin or cheesecloth bags in lots of 5 to 20 grams and placed in an open dish with sufficient cloth or moist sand to maintain a desired water content.

In an early test it was found that treated seed (6 years old) germinated above 90 per cent when sown on soil in the greenhouse while a sample from the same lot wrapped in cheesecloth and placed in a moist chamber at 26° C. showed no germination.

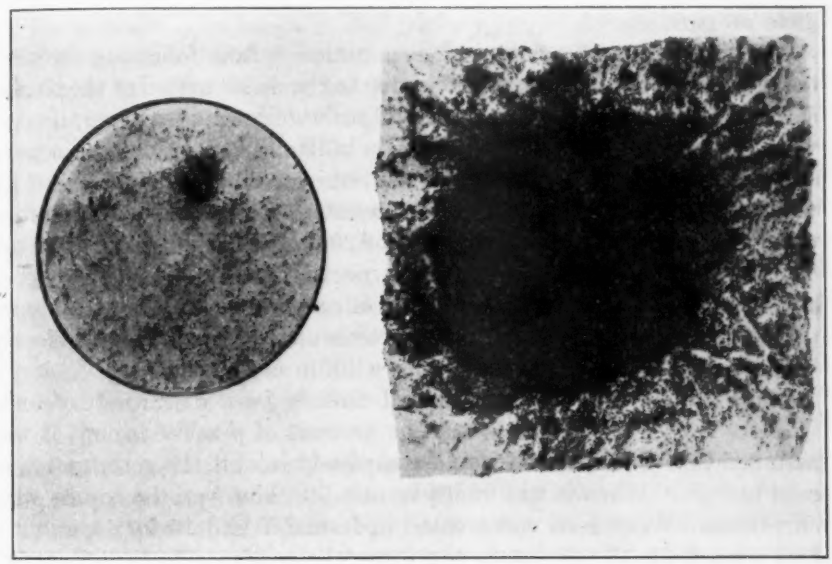

FIG. 1. Tobacco seed treated in mercuric chloride. Germination in muslin bag and on filter paper in petri dish.

More extensive tests were then made with both treated and untreated seed using the two methods of germination described above. The results may be summarized as follows: In the glass dishes, 10 samples from 4 different corrosive sublimate treatments averaged 90.6 (82–97) per cent germination while 5 comparable untreated samples averaged 93.8 (89–98) per cent germination. There was in some cases a noticeable slowing in the rate of germination of the treated seed. This was apparently responsible for part at least of the slight differences noted above. In striking contrast were the results of attempts to germinate treated and

untreated seed in bulk (figure 1). Five lots of seed treated in mercuric chloride gave no germination whatever. Even when one lot was spread in a large moist chamber in a layer about 1 centimeter deep there was still no sign of germination. The germination of untreated seed in cloth bags was very irregular. Due to the fact that the rate and percentage of germination was much higher in the exterior part of the mass, it was impossible to obtain counts representative of the entire lot. Three such tests gave maximum counts of 57, 61 and 64 per cent. A count from the interior of the last lot, however, showed only 10 per cent of germination. One lot at 33° C. and another at 26° C. with excessive watering gave no germination.

As evidence that the failure of germination in bulk following the mercuric chloride treatment is probably due to the direct action of the chemical, it may be noted that seed treated in the following ways germinated very much as did untreated seed both in bulk and in petri dishes: copper sulfate, 2 per cent and 5 per cent solutions for 20 minutes followed by washing in lime water; potassium dichromate, 10 per cent for 10 minutes; potassium permanganate, 5 per cent for 20 minutes; sulfuric acid, 10 per cent for 5 minutes. Germination was especially good following the copper sulfate treatment. However in the concentrations used this material did not seem to entirely inhibit the bacteria on seed which had previously been soaked in a suspension of the wildfire organism.

Since formaldehyde treatment had already been discarded by some workers for use with tobacco seed on account of possible injury, it was assumed that this material would completely inhibit the germination of seed in bulk. When it was finally resorted to, however, the results were surprising. When seed was treated in formalin 1 to 16 for 15 minutes and washed for 15 minutes in tap water the germination in bulk at 26° C. appeared to the eye to be practically as good as that of the untreated control. Counts from the interior of the mass, however, showed a considerably higher germination in the untreated seed (61 per cent as compared with 29 per cent in the treated lot).

Here again the germination was very much better in both lots next to the cloth on the outside of the mass. In a second trial, seed was treated in a 1 to 16 solution for 10 minutes and washed in running water for 10 minutes. There was evidence of slight injury when this seed was germinated in petri dishes but in bulk there was no significant difference in the percentage of germination as determined by counts from the interior of the mass. The use of this material should be investigated further if the practice of germinating the seed in bulk is to be continued.

When seed was sown on soil in the greenhouse there was strong and uniform germination in that treated in mercuric chloride as well as in untreated seed. This was likewise true of seed treated in copper sulfate solution, 2 per cent for 20 minutes, and sulfuric acid solution, 10 per cent for 5 minutes.

SOME FACTORS INFLUENCING THE GERMINATION OF SEED

In view of the results recorded above and of those described by Anderson and Chapman (1) it seemed desirable to examine some of the factors, other than treatment with chemicals, which might influence the germination of tobacco seed.

Temperature. In an early trial with rather poor seed no germination could be obtained at 33° C. either in glass dishes or in bulk. At 26° C. the same lot gave 51 per cent germination in bulk and as high as 78 per cent in petri dishes. A later test in petri dishes with better seed gave in 4 samples an average of 18.7 per cent germination at 33° C. and 90.2 per cent at 26° C. No controlled temperature was maintained below 26° C. but splendid germination was obtained at laboratory temperatures ranging usually from 21° to 25° C.

These observations indicate a rather sharply defined maximum temperature for the germination of tobacco seed and point to a source of possible loss of seed under the farm practice of germination at extremely variable temperatures.

Moisture. In 2 tests a total of 10 samples were germinated in glass dishes in which the sand received slightly more water than it would take up though not enough to immerse the seed. Seven samples were run in parallel on sand to which was added barely enough water to moisten it. No appreciable difference in percentage of germination resulted. In seed in muslin bags with heavy watering, however, germination was poor or lacking entirely.

Aeration. It has already been noted that seed on the outside of a mass in bulk germinated more readily than those in the interior of theugh mass. To study this factor further two columns of seed 1¾ inches high were placed over water in glass cylinders 1¾ inches in diameter. The cylinders were sealed in a series so that moist air could be drawn through one lot of seed while it merely circulated in the space above the other lot. Germination was about equal in the two lots extending practically to the bottom of the column. A second test was made with columns of seed 6 inches in height. After 11 days there was good germination to within ½ inch of the bottom in the column which received better

aeration, while in the corresponding cylinder germination was practically inhibited beyond 3½ inches from the top of the column.

Drying. Treated seed which was dried in direct sunlight germinated as well as seed dried slowly in the laboratory and in a few cases somewhat better than seed which was not dried after treatment. Seed which was soaked in water and dried without treatment was not perceptibly changed in its power of germination. This is not in agreement with the results obtained by Anderson and Chapman (1).

Age of seed. Seed up to 6 years old has shown good germination under favorable conditions. One lot of seed 5 years old consistently gave above 60 per cent germination.

Rate of development of seedlings from germinated and dry seed. In order to compare the growth of seedlings from seed germinated previous to sowing with that of plants from dry seed, 2 greenhouse beds of equal size (8.5 sq. ft.), were sown with equal quantities of seed by weight, the first germinated and the second dry. Seedlings in the first bed were distinctly in advance of those in the second for several weeks but by the time the plants had reached a size suitable for transplanting the difference between the two beds was not marked. The plants from these beds were pulled after 52 days and weighed immediately. The weight for the first bed was 3332 grams and for the second 2990 grams. While these weights seemed to represent the conditions of the beds fairly well the presence of damping-off in the beds sets in doubt the value of the figures. A third bed to which a fungicide was applied in addition to formaldehyde treatment received by the first and second beds, produced a green weight of 3502 grams from a sowing of dry seed. The above test was repeated in duplicate with similar results as regards the appearance of the plants up to 38 days, after which the experiment was discontinued.

DISCUSSION OF SEED TREATMENT

In the light of the results and observations recorded above it seems fairly certain that tobacco seed, treated by the usual corrosive sublimate method and germinated in bulk, retains a sufficient quantity of the chemical in the seed coat to seriously interfere with the germination of the seed. The results show that the germination of such treated seed is only slightly if at all impaired when it is sown on greenhouse soil or on moist filter paper on sand in the laboratory. It is apparent further that the method of germination in bulk may expose the seed to other hazards that are avoided by sowing the seed directly on the plant bed without

sprouting. Poor aeration and high temperatures are especially likely to hinder germination. When seed previously germinated is sown side by side with dry seed on greenhouse beds, the difference in rate of development of the seedlings is not marked. Indeed after several weeks it is scarcely perceptible. While seed treated in various chemicals other than mercuric chloride has germinated as well as untreated seed under both the methods employed, none of these can at this time be considered desirable for general use without further investigation.

It seems therefore that the most satisfactory method of handling seed for the control of wildfire under New York conditions consists in treatment with corrosive sublimate and sowing the seed directly on the plant bed without previous germination.

SUMMARY

Tobacco seed treated in mercuric chloride 1 to 1000 germinated nearly or quite as well on soil and in thin sowings in moist chambers as did untreated seed. When seed from the same treated lots was held in bulk in muslin or cheesecloth bags no germination was obtained at 26° C. or at 33° C.

Untreated seed in bulk did not germinate as well as did samples from the same lots germinated in petri dishes.

Seed treated in copper sulfate, potassium permanganate, potassium dichromate, and sulfuric acid did not show appreciable injury in the concentrations tested.

Treated and untreated seed germinated well in petri dishes at 26° C. and below. At 33° C. poor germination was obtained.

Drying of wetted seed rapidly in direct sunlight or slowly in the laboratory did not impair germination in these experiments.

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(4) ————. Blackfire or angular leaf-spot of tobacco. Va. Agric. Exp. Sta. Tech. Bul. 25: 1-43. *2 pl., 18 fig.* 1923. Literature cited, p. 42–43.

(5) WOLF, F. A. Wildfire of tobacco. N. C. Agric. Exp. Sta. Bul. 246: 1–27. *7 figs.* 1922. Literature cited, p. 27.

THE BEHAVIOR OF CERTAIN VARIETIES OF TOMATOES TOWARDS FUSARIUM-WILT INFECTION IN CALIFORNIA

MICHAEL SHAPOVALOV AND J. W. LESLEY

WITH PLATES VII AND VIII

Wilt of tomatoes, caused by *Fusarium lycopersici* Sacc., is widely spread in the tomato growing sections of California. In 1922 and 1923 the disease was seen in all the principal tomato sections of the State, notably in those near the coast, such as the Santa Clara and San Fernando Valleys and Orange County. In coastal sections Fusarium wilt is more important than western yellow blight. In the interior valleys the relative importance of these two diseases is as a rule reversed; the season of 1923 was probably exceptional in that even in the interior the wilt disease was more prevalent than blight. There has been a great deal of confusion in regard to the relative importance of these two diseases among the general public and the growers, the latter frequently referring to Fusarium wilt as "the blight." Undoubtedly wilt causes very serious losses to the tomato industry in California. It is exceptional to find a tomato field entirely free from the disease. Very frequently it destroys from 5 to 10 per cent and sometimes as much as 85 per cent of the crop. In all probability the area of the infected land is steadily increasing as a result of repeated planting of tomatoes in the same field often without rotation.

The work of various Experiment Stations and the United States Department of Agriculture in breeding wilt resistant varieties has been very successful and as a result a number of varieties are now in existence which have proved to be wilt resistant under certain conditions.[1] Notable among these varieties are those developed by Pritchard.[2] Whether these varieties would maintain their resistance in California was uncertain, owing to the different environmental conditions both climatic and, perhaps, biological under which tomatoes are grown in the State. The purpose of the present investigation is twofold: (1) to study the behavior of wilt resistant varieties from other states when grown under California conditions and (2) to test out selections made in California. It is hoped in this way to find or develop resistant varieties well adapted for local commercial plantings. Seeds for this purpose

[1] The intrinsic resistance of certain tomato varieties to the wilt disease was pointed out by Essary in 1912 (Tenn. Agr. Exp. Sta. Bull. 95, *12 p., 7 figs.* 1912).

[2] Pritchard, Fred. J. U. S. Dept. Agr. Bull. 1015, *18 p., pls. I–X.* 1922.

were obtained from seedsmen and experiment stations. These and some selections made by one of us[1] in the summer of 1922 in badly wilted tomato fields in California were subjected to tests in 1923. For convenience these varieties, strains and selections will be referred to here as varieties indiscriminately. As a control Stone was used, a variety widely grown in California and one which is very susceptible to wilt.

Two methods were employed in testing the reaction of varieties, artificial inoculation with a pure culture, following the general procedure described by Edgerton and Moreland[2] and natural infection obtained by planting in the soil of badly infected fields. For the former method a pure culture of the pathogene is of course necessary and since as noted by Edgerton (l. c.) not all Fusarium cultures from wilting plants are pathogenic, two distinct cultures were employed which had been isolated by one of us[3] from the diseased plants, collected in California. One of these, designated as F. IV, was isolated from a wilted tomato plant near San Jose, Cal., in July, 1922, and the other, designated as F. V, was isolated in July, 1922, from a wilted plant at Pomona, Cal. The artificial inoculation method was used in an experiment conducted at the Citrus Experiment Station at Riverside on four varieties. Two of these, Stone and Morse's San Jose Canner, are varieties of commercial importance in the State. The third variety, Norton, bred by Pritchard, is also becoming of commercial importance and has proved to be wilt resistant in other parts of the United States and the fourth, No. 23087, is a selection made in 1922 in a badly wilted field of Stone in California.

Twenty four-inch pots with garden soil containing plenty of humus were sterilized at 20 lbs. pressure on three successive days, one hour each day. All pots were covered during the sterilization with heavy wrapping paper and the covers were not removed until the time of planting the seed. Some of the pots were then inoculated with the above mentioned cultures by first removing about two inches of soil from the pot to a disinfected dish, than introducing the contents of a two-week old test-tube culture, grown on string bean pods, after which the soil was replaced. Some pots were not inoculated with either of the two fungi. All the pots were then sown with seed, twenty-eight seed per pot. The seed was disinfected by soaking in 1:400 commercial formaldehyde for one hour, rinsed in distilled water and dried on filter paper before

[1] J. W. Lesley.

[2] Edgerton, C. W., and Moreland, C. C. La. Agr. Exp. Sta. Bull. 174. *54 p., 19 figs.* 1920.

[3] Michael Shapovalov.

planting. The pots were placed in saucers and crocks filled to a depth of about 5/8 inch with water. All dishes and the dibbles used in seed planting were disinfected in 1 per cent commercial formaldehyde. As soon as the plants had developed their first true leaves disease made its appearance in some of the pots, causing the collar or part of the hypocotyl next the soil to shrink and become discolored as in "damping off." On June 8, 1923, about half the seedlings of Stone and San Jose Canner in the pots inoculated with F. V. had died, but only one out of ten plants of the variety 23087 and none of Norton were affected. None of the plants inoculated with F. IV showed disease, indicating that this culture was either less virulent or non-pathogenic. One seedling of Stone uninoculated damped off, presumably owing to accidental infection.

On June 14 all of the San Jose Canner and all but two of Stone inoculated with F. V had died and the remaining inoculated and uninoculated plants were set out in the field. This field had never before been in tomatoes. At the time of planting some plants of each variety from the uninoculated pots were inoculated with F. V by placing a culture in contact with the roots. To serve as controls some plants of each variety were not inoculated either in the pot or in the field. Each variety then consisted of a series of four fractions, pot inoculated with F. V, field inoculated with F. V, pot inoculated with F. IV and uninoculated.

Nearly all the plants set out became established. Four weeks after setting out typical wilt symptoms appeared among the series of varieties inoculated with F. V. The plants inoculated with F. IV, however, showed no symptoms of wilt (except two plants referred to below) behaving in the same way as the uninoculated controls. Differences in the reaction of the four varieties to the culture F. V were again apparent as with the inoculated seedlings when in pots. Nearly all of Stone and San Jose Canner became diseased. Later a few plants of these varieties put up side shoots, but these in turn quickly became infected. On August 3, both of the F. V pot inoculated plants of Stone were dead and of those field inoculated only one plant of Stone and two small plants of San Jose Canner survived, although severely affected. On October 29, the combined yield of these plants was nine immature fruits, two largest being barely of marketable size and the majority smaller than walnuts. In plate VII, the contrast is well shown between that section of a row which had F. V field inoculated plants of San Jose Canner (a) and Stone (b), and another part of the same row planted with uninoculated San Jose Canner (c) and the adjacent row (d) planted with F. IV inoculated plants of several varieties.

Quite different was the reaction of Norton and the Stone selection No. 23087. On August 3, about one-fourth of the F. V pot inoculated plants of these varieties had perished, but the others either appeared unaffected or, if diseased, had begun to make healthy growth. The new growth, unlike that of Stone and San Jose Canner, did not become diseased and ultimately about 75 per cent of the plants of these varieties produced a satisfactory crop, in part quite equal to that of the controls. Forty-four out of forty-six plants inoculated with F. IV showed no Fusarium symptoms and only two developed slight signs of wilt. This was probably due to outside infection of the pots in watering or other accidental agency, or, perhaps, to the presence of the fungus in the field.

TABLE 1—*Riverside plot.*

Variety	Treatment	Total number of plants	Apparently healthy	Slightly affected	Medium affected	Severely affected	Died of Fusarium			
							Prior to July 14	From July 14 to Aug. 3	From Aug. 3 to Aug. 29	Total number
Selection 23087 from Stone	Pot inoculated, F. V.	6		3	1		2			2
Norton (from Haven Seed Co.)	" " "	10		7			3			3
Stone (from Haven Seed Co.)	" " "	2					1	1		2
San Jose Canner (from Morse Seed Co.)	" " "	All died in pot								
Selection 23087	Field inoculated, F. V	12		8	1		1	2		3
Norton	" " "	12		10			1	1		2
Stone	" " "	15			1		4	9	1	14
San Jose Canner	" " "	11				2		9		9
Selection 23087	Pot inoculated, F. IV	10	10							
Norton	" " "	9	7	2						
Stone	" " "	20	20							
San Jose Canner	" " "	7	7							
Selection 23087	Uninoculated	13	13							
Norton	"	12	12							
Stone	"	11	11							
San Jose Canner	"	12	12							

These data, summarized in table 1, show clearly that under the growing conditions which obtained in 1923 one of the cultures employed, F. IV, is merely a saprophytic Fusarium, while the other, F. V, is a parasite and may cause typical Fusarium wilt. The principal cultural and morphological features of F. V correspond very closely to those of *F. lycopersici* a culture of which was obtained from Mr. Pritchard's collection (His No. 103). As to the varietal susceptibility, both Stone

and Morse's San Jose Canner appeared to be very susceptible and about equally so to this pathogene, whereas 23087 and especially Norton showed distinct resistance.

The second method of testing the reaction of varieties, namely natural soil infection, was employed in two fields, one at La Mesa, near San Diego, the other at Chatsworth, in the San Fernando Valley. The La Mesa field had been in tomatoes for the last two seasons, each time 85 per cent of the plants being badly diseased. On this plot four varieties were planted, Norton, Norduke and Marvel, all of which are known elsewhere as wilt resistant, and Stone as a control. All the plants were grown in adjacent seedbeds near Santa Ana, Orange County,[1] and appeared quite healthy when set out on May 15. The Stone plot rapidly developed wilt. On September 9 the majority of the plants were dead, only 5 per cent surviving and these were severely affected. Practically no fruit was obtained from the total of 140 plants. A striking contrast was presented by the adjacent plots of Norton, Norduke and Marvel (Plate VIII). The majority of plants of these varieties were only slightly wilted

TABLE 2—*La Mesa plot.*

Variety	Source	Total number of plants	Slightly affected		Medium affected		Severely affected		Died of Fusarium	
			Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Stone	Haven Seed Co.	140					7	5	133	95
Norton	" " "	47	12	25	24	50	11	25		
Norduke	" " "	55	30	55	22	40	3	5		
Marvel	" " "	13	8	62	5	38				

(Table 2), Norton showing somewhat more disease than Norduke, while Marvel was the least affected. All three varieties made a fairly good crop. Norton although more diseased was superior to both Norduke and Marvel in production. The yield of Norduke plants seemed very variable and the crop matured late in the season. This variety made the best vegetative growth. Marvel gave a good yield of smaller fruit. All of the three, Norton, Norduke and Marvel, are therefore sufficiently wilt resistant to produce a crop which would be considered

[1] Mr. A. B. Haven of the Haven Seed Co., Santa Ana, California, kindly supplied all the seedlings used in this trial and many of the seeds used in the other trials.

satisfactory to a tomato grower whereas under similar field conditions Stone appears so susceptible that it produces no crop.

The other field trial, conducted at Chatsworth, like that at La Mesa was on land so badly infected with the wilt Fusarium that the tomato crop of the previous year was practically a total failure. Part of the seeds in this trial were sown in a seedbed containing an admixture of infected soil from this field. Many of the resulting seedlings showed symptoms similar to those seen in the artificially inoculated pots at Riverside indicating an early infection. A considerable number of plants from the infected seedbed died soon after setting out in the field, especially of the susceptible varieties. To what extent this mortality was due to *F. lycopersici* and to what extent to other causes was not ascertained, consequently such plants are merely classified as died from undetermined cause (Table 3). Other seedlings were raised in an uninfected seedbed. Very few of these died without first becoming established.

The reaction of the varieties included in this test to Fusarium wilt is shown in table 3. The number of varieties tested was thirty-three and the average number of plants of each was forty-six, but varied from as few as 7 up to 194. The results with plants from infected and uninfected seedbeds not being strictly comparable are shown separately. In some cases where the same or similar varieties were included in both groups comparison indicates that the relative susceptibility of the varieties is approximately the same in the two groups although the plot from the infected seedbed showed a higher mortality among the young plants and more severe symptoms of the disease. In some varieties replicate one-row plots each containing about fifty plants were planted, these plots being separated as widely as possible. The results from such plots are shown separately (Table 3).

Field planting took place on June 18 in rows six feet apart with four feet between the plants in the row. Five weeks later many of the plants were severely wilted and in a dying condition. *F. lycopersici* was isolated from the diseased plants. Differences in the intensity of the Fusarium wilt symptoms among varieties were evident and became accentuated as the season advanced. As was expected the control variety Stone proved very susceptible, so much so that on October 16 over 50 per cent had died from wilt. Morse's San Jose Canner also proved very susceptible. On the other hand a large number of varieties proved to be resistant. Among these were Norton, Norduke and Marvel, thus confirming the results obtained at Riverside and La Mesa. Most of the varieties bred for wilt resistance by State Agricultural Experiment

TABLE 3—*Chatsworth Plot.*

Plants from infected seedbed	Total number of plants	Apparently healthy		Slightly affected		Medium affected		Severely affected		Number died of Fusarium			Per cent died of Fusarium	Number died from undetermined cause		Per cent died from undetermined cause
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Prior to July 25	From July 25 to Aug. 21	From Aug. 21 to Oct. 16		Prior to July 25	From July 25 to Aug. 21	
Illinois New Century[1]	40			26	65			1	2					13		33
Illinois Imperial[1]	50			42	84	3	6			1	1		4	3		6
Indiana 717–476[2]	47	2	4	5	11	8	17	15	32	1	6	2	19	6	2	17
Indiana 604–492[2]	31							1	3	1	6	18	81	3	2	16
Indiana 725–513[2]	24			15	63	4	17	2	8		2	1	12			
Missouri 306[3]	50			43	86	2	4			1			2	3	1	8
Missouri 208[3]	16			11	69	4	25	1	6							
Arkansas Wilt resistant[4]	25			19	76					1		1	8	4		16
San Jose Canner[5]	31			1	3	4	13	3	10	3	5	8	52	4	3	22
Selection 23.090[6]	49			20	41	11	23	1	2	1	2	7	20	5	2	14
Selection 23.091[6]	48	3	6	29	61	3	6					1	2	10	2	25
Stone[7]	48					1	2	2	4	7	11	12	63	13	2	31
Stone[7]	50	1	2	1	2			2	4	3	15	6	48	20	2	44
Selection 23.087[8]	42			20	48	6	14	5	12		3		7	5	3	19
Selection 23.088[8]	47					1	2	1	2	3	24	6	70	8	4	26
Selection 23.088[8]	35			4	12	5	14	5	14		4	11	43	4	2	17
Selection 23.089[8]	50			5	10	2	4	9	18	5	10		30	12	7	38
Mo. 301A, Norton sel.[3]	18			15	84	2	11							1		5
Mo. 218, Norton sel.[3]	8			7	88									1		12
Mo. 238, Columbia sel.[3]	8			7	88	1	12									
Ind. 673–436 (Greater Baltimore sel)[2]	18			1	5			3	17		2	9	61	2	1	17
Mo. 345, Globe sel.[3]	7			2	29	4	57	1	14							
Tennessee Beauty[9]	24			12	50	5	21			1	3		17	2	1	12
Louisiana Red[10]	8			7	88			1	12							
Mo. 318, La. Red sel.[3]	56			54	93	1	1									

TABLE 3—*Continued.*

TABLE 3—*Continued.*

Plants from infected seedbed	Total number of plants	Apparently healthy		Slightly affected		Medium affected		Severely affected		Number died of Fusarium			Per cent died of Fusarium	Number died from undetermined cause		Per cent died from undetermined cause
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Prior to July 25	From July 25 to Aug. 21	From Aug. 21 to Oct. 16		Prior to July 25	From July 25 to Aug. 21	
Mo. 316, La. Red. sel.[3]	32			30	94	1	3							1		3
Louisiana Pink[10]	32			29	91	2	6							1		3
Mo. 105, Marvel sel.[3]	10			9	90	1	10									
Mo. 352, Marvel sel.[3]	32			30	94	1	3							1		3
Mo. 226, Marvel sel.[3]	22			17	77	1	5	2	9					2		9
Plants from uninfected seedbed																
Marvel[7]	50			47	94	1	2							2		4
Globe[7]	50			46	92	2	4	1	2					1		2
Globe[7]	49			20	41	22	45	4	8			1	2	1	1	4
Globe[7]	43			28	65	14	33	1	2							
Columbia[7]	50			38	76	4	8					2	4	5	1	12
Norduke[7]	48	1	2	45	94	1	2							1		2
Norduke[7]	50			50	100											
Norton[7]	50	1	2	42	84							1	2	6		12
Norton[7]	45	1	2	35	79	2	4	1	2		1		2	5		11
Norton[7]	50	1	2	44	88	1	2							2	2	8
Norton[7]	49	2	4	41	84					1		2	6	2	1	6
Stone[7]	50			1	2	6	12	11	22		2	27	58	3		6
Stone[7]	43	1	2			4	9	12	28		1	21	52		4	9

[1] From J. W. Lloyd, Ill. Agr. Expt. Sta. sel. by C. E. Durst.
[2] From Ind. Agr. Expt. Sta.
[3] From J. T. Rosa, Calif. Agr. Expt. Sta.
[4] From H. R. Rosen, Ark. Agr. Expt. Sta.
[5] From Morse Seed Co.
[6] Selection from Jap Canner.
[7] From Haven Seed Co.
[8] Selection from Stone.
[9] From S. H. Essary, Tenn. Agr. Expt. Sta.
[10] From C. W. Edgerton, La. Agr. Expt. Sta.

Stations were also in the resistant class. Other varieties formed an intermediate class, being neither as susceptible as Stone nor as resistant as Norton. An Indiana Station selection (23.105) and Tennessee Beauty belong to this intermediate class. Other varieties again apparently bred for wilt resistance elsewhere appeared in this test to be almost as susceptible as Stone. Possibly then a few varieties, or perhaps more precisely selections, from other states fail to develop their wilt resistant qualities under California conditions. Whether or not these are selections showing definite wilt resistance in the places of their origin has not been ascertained, but if so they are exceptions as the majority of varieties have maintained their wilt resistance when introduced into California. The variety Globe was resistant although it showed more disease than Norton or Norduke. Two of the selections made by one of us in California tomato fields in the previous season are quite promising. One of these, 23087, a Stone selection, is in the resistant class, but hardly equal to Norton in this respect. The other is a selection from a susceptible variety largely grown in the Santa Clara Valley and known locally as Jap Canner. A first step has therefore been taken towards developing a wilt resistant strain of this variety so extensively grown in commercial fields of the State.

With regard to yield no exact data have been secured, but the production from resistant varieties far exceeded that from the susceptible. In particular the variety Norton produced a very good crop. In certain sections of California where Stone is now extensively grown Norton is far preferable for planting on wilt infested land. Norduke also gave a good yield although maturing later than Norton. A special merit of Norduke for California conditions, in addition to the wilt resistant quality, is its abundant foliage which should tend to diminish the injury from sunburn. Other varieties in the resistant class gave good yields, notably Illinois Imperial, Illinois New Century, Marvel, Columbia and Louisiana Pink. Certain of the resistant early varieties, such as Louisiana Red and Globe gave satisfactory yields, but the fruit was relatively small and the foliage too scanty which is a disadvantage wherever sunburn is a serious menace. The class intermediate in susceptibility to wilt was inferior to the resistant class in yield while the susceptible varieties gave practically no crop. Ninety-eight plants of Stone from the infected seedbed gave a yield hardly equal to that of one average plant of Norton.

Effect of artificial inoculation with *Fusarium lycopersici* at Riverside, Cal., in 1923; (a) inoculated San Jose Canner; (b) inoculated Stone; (c) uninoculated San Jose Canner and (d) the same varieties inoculated with a non-pathogenic culture.

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Behavior of resistant and susceptible varieties on the land badly infested with *Fusarium lycopersici* at La Mesa, Cal., in 1923: Stone in the foreground and Norton, Norduke and Marvel in the background.

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SUMMARY

The reaction of a number of tomato varieties to the wilt fungus, *Fusarium lycopersici* Sacc., has been tested. Two methods of testing were used, artificial inoculation with pure culture of the fungus and natural field infection. In the former method two distinct cultures of Fusarium were employed, both having been isolated from wilted plants in California. One of these cultures proved to be parasitic, causing the typical Fusarium wilt disease. Three plots in places widely separated in Southern California and involving two methods of testing gave quite consistent results. The variety Norton proved resistant in all three places. Norduke, Marvel and a California selection from Stone (23.087) were resistant in both localities where tested. Most but not all of the varieties bred for wilt resistance at various Experiment Stations, also the variety Livingston's Globe, proved resistant to wilt when planted in badly infected soil in California.

PHYTOPATHOLOGICAL NOTES

An early report on infectious chlorosis.—Lawrence, John, A.M., Rector of Yelvertoft in Northampton-shire, and sometime Fellow of Clare-Hall in Cambridge. "The Clergy-Man's Recreation: Shewing the Pleasure and Profit of the Art of Gardening." Published in London in 1715. (The introduction, however, bears the date March 15, 1713.)

"Suppose a plain Jessamine Tree,[1] spreading itself into 2 or 3 branches from one common Stem near the Root. Into any one of these Branches in August inoculate a Bud taken from a yellow strip'd Jessamine, where it is to abide all Winter; and in the Summer, when the Tree begins to make its Shoots, you will find here and there some Leaves ting'd with Yellow, even on the other Branches not inoculated, till by degrees in succeeding Years the whole Tree, even the very Wood of all the Branches, shall be most beautifully strip'd and dy'd with Yellow and Green intermix'd. It is not material whether you cut off the Branch above the Inoculation to make the Bud it self shoot; for it will have the same Effect of tinging by degrees all the Sap of the Tree, as it passes by or through this Bud, and communicating its Virtue to the most distant and opposite Branches, tho' the Bud it self should not shoot out. Nay I have my self several times experienc'd that if the Bud do but live two or three Months, and after that happen to die, or be wounded by any Accident, yet even in that little time it will have communicated its Virtue to the whole Sap, and the Tree will become entirely strip'd. This Discovery undoubtedly proves the Circulation of the Sap. Q. E. D."

That this variation was recognized as pathological is shown by a citation from Richard Bradley, Professor of Botany in the University of Cambridge and Fellow of the Royal Society, "New Improvements of Planting and Gardening," of which the first edition was published in 1717, who refers to "the unwholesome Tincture communicated to the Plant from the striped Bud." Bradley's book has a chapter on blights, in which, among other things, he treats on the prevention of smut in wheat (p. 222). "The Receipt to prevent Wheat from being smutty * * * * teaches us first to wash the Wheat through three or four several Waters, stirring it round each time with a large Stick backwards and forwards with great Force, and with a Skimmer each time take off all the light Wheat. When this is done, put your Wheat into a Liquor prepared in this manner:

[1] This jessamine is in all probability *Jasminum officinale* Linn.

"Put into a large Tub, which hath a Tap, a sufficient Quantity of Water; then put as much Salt into it, as, when 'tis well stirr'd about, will make an Egg swim; then add as much more Salt as was before, and stir it very well; and to this put two or three Pounds of Allom beaten very fine, and stir it about.

"This you are to use as you do your ordinary Brines, only you must let your Wheat steep thirty or forty Hours, for less signifies nothing; tho' the common Opinion is, that steeping so long kills the Seed in the Wheat; but Experience teaches the contrary.

"You must take your Wheat out the Night before you sow it, and sift some slak'd Lime on it, which serves only to make it dry enough to sow. 'Tis necessary to add some more Water to the Brine in a Week or ten Days time, as it wastes, and Salt proportionable to the Water, and about a Pound of Allom.

"Note, Many Farmers steep their Wheat in a Brine, yet have Plenty of Smutty Wheat, because they don't make their Brine strong enough, and take their Wheat out too soon.

"Note also, Many Farmers have suffer'd greatly by Smutty Wheat, especially in a dear Year, when such Wheat will not sell for above Five or Six Shillings a Bushel; whereas that which is free from Smut, will sell for Ten, Eleven, or Twelve Shillings; and such Smutty Wheat being eaten chiefly by the poorer People, and being unwholesome, occasions Sickness; Therefore, for the Benefit of the Publick, this is printed."—W. A. ORTON.

Personals: Prof. G. B. Traverso, formerly vice-director of the Royal Station of Plant Pathology at Rome, on November first assumed the Professorship of Plant Pathology at the Royal School of Agriculture at Milan. His present address is R. Scuola Superiore di Agricoltura, Laboratorio di Patalogia Vegetale, via Marsala, Milano, Italia.

REPORT OF THE FIFTEENTH ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The fifteenth annual meeting of the Society was held at the University of Cincinnati, Cincinnati, Ohio, December 27, 1923 to January 1, 1924 inclusive, in conjunction with the American Association for the Advancement of Science and affiliated scientific societies. President G. R. Lyman presided and there were approximately 145, or 26 per cent of the members present. This is the largest annual gathering of the Society that has ever been held, the attendance at the Boston, Toronto and Chicago meetings being 95 (17 per cent), 85 (16 per cent), and 110 (21 per cent) respectively. The headquarters of the Society this year were at the Hotel Gibson at Cincinnati.

One hundred and fourteen papers were presented at the regular sessions of the Society. Eight papers were read at special sessions, and six papers of especial interest to members were given at the Potato Scab symposium of the Potato Association of America. The number of papers on the regular program at Boston in 1922 was 79, at Toronto in 1921, 97, and at Chicago in 1920, 80. Abstracts of the papers were printed in Phytopathology (Phytopath. **14**: 24–66. Jan. 1924.) and a popular summary of the meeting has appeared in a special number of Science. (Science **59**: 98–100. Feb. 1, 1924.)

There were three joint sessions with other societies. The regular joint session with Section G of the American Association for the Advancement of Science was held on Friday afternoon, December 28 and the following papers were presented: *The Fluorescent Colors of Plants, their Occurrence and Meaning*, by F. S. Lloyd, retiring Vice President of Section G; *The Relation of Environment to Disease of Plants*, by L. R. Jones; *Recent Advances in Cytology*, by L. W. Sharp; and *Cell Activity and H-ion Concentration*, by B. M. Duggar. On Saturday afternoon the Society combined programs with the Mycological Section of the Botanical Society of America in the presentation of general mycological and pathological papers and on Saturday forenoon joined with the American Society of Horticultural Science and the Horticultural Inspection Section of the American Association of Economic Entomologists in a symposium on the subject of crown gall inspection. The purpose of this symposium was to weigh the evidence concerning the economic importance of crown gall, to review the inspection methods now in use, and to formulate recommendations for the improvement of these methods. Four members of a special committee, M. J. Dorsey, representing the horticulturists, Henry B. Chase, representing the nurserymen, Harry F. Dietz, a nursery inspector, and I. E. Melhus, a plant pathologist, presented papers embodying their views on crown gall inspection and giving the results of questionnaires that previously had been submitted to the membership of the societies and associations represented. After the symposium the committee worked out a set of rules or principles which may be applied in such a way as to bring about more uniform and more satisfactory methods than those now in use. This report, which represents a definite accomplishment of the meeting, was adopted by this Society and by the American Association of Economic Entomologists. It has been made available through publication in Phytopathology and the official organs of the nursery associations, as well as by means of the distribution of mimeographed leaflets.

The annual dinner of the Society was held on Saturday evening, December 29, at the Hotel Gibson, and was attended by one hundred and fifty-six persons, of whom one hundred and forty were members of the Society.

The following officers were elected:

President, F. D. Fromme, Virginia Polytechnic Institute, Blacksburg, Va.

Vice President, J. H. Faull, University of Toronto, Toronto, Canada.

Councilor for two years, C. R. Orton, Pennsylvania State College, State College, Pa.

Councilors for one year (chosen by the Divisions of the Society): B. T. Dickson, Macdonald College, Quebec, representing the Canadian Division; F. D. Heald, State College of Washington, Pullman, Washington, representing the Pacific Coast Division; and C. A. Ludwig, Agricultural Experiment Station, Clemson College, South Carolina, representing the Southern Division.

The members of the Editorial Board of *Phytopathology*, whose terms expired at the close of 1923, namely: Perley Spaulding, Editor-in-Chief; L. L. Harter and N. J. Giddings, Editors; and G. R. Bisby, J. Franklin Collins, L. R. Hesler, and A. G. Johnson, Associate Editors; were requested to continue to serve until such time as new editors and associates can be carefully selected by the Council; Business Manager for one year, R. J. Haskell, U. S. Department of Agriculture, Washington, D. C.; Advertising Manager for one year, R. G. Pierce, U. S. Department of Agriculture, Washington, D. C.

Member of the Editorial Board of American Journal of Botany for two years to complete the unexpired term of D. Reddick, resigned (chosen by the Council): G. R. Bisby, Agricultural College, Winnipeg, Manitoba, Canada.

Representatives on the Council of the American Association for the Advancement of Science for one year (chosen by the Council): G. P. Clinton, Agricultural Experiment Station, New Haven, Connecticut, and W. A. Orton, U. S. Department of Agriculture, Washington, D. C.

Representatives on the Council of the Union of Biological Societies for one year (chosen by the Council): the Editor of *Phytopathology* and the Secretary of the Society.

Members of the Advisory Board (chosen by the Council): N. J. Giddings, University of West Virginia, Morgantown, West Virginia, for three years to succeed C. R. Orton as Commissioner for the Northeast, and M. W. Gardner, Indiana Agricultural Experiment Station, Lafayette, Indiana, for three years to succeed G. H. Coons as Commissioner for the Middle West.

Trustee of the Tropical Plant Research Foundation for five years (chosen by the Society): L. R. Jones, University of Wisconsin, Madison, Wisconsin.

Representative on the committee for an International Botanical Congress in 1925 (chosen by the Council): H. H. Whetzel, Cornell University, Ithaca, N. Y.

Representatives on crown gall committee (chosen by the Society): F. C. Stewart, Agricultural Experiment Station, Geneva, N. Y., and I. E. Melhus, Agricultural Experiment Station, Ames, Iowa.

REPORT OF THE TREASURER FOR 1923

STATEMENT OF ACCOUNTS FOR 1923, AS OF DEC. 20, 1923

Receipts:

Balance from 1922	$1,326.78
Annual dues	3,426.00
Contribution to cover cost of Phytopathology to European pathologists	105.00
Subscription received with annual dues	5.50
Excess dues	9.04

Subscriptions to Oberly Memorial Fund received with annual dues	53.01	
Interest on checking account	23.34	
Interest on time deposit of $1500, 6 mos. at 4%	30.00	
		$4,978.67
Expenditures:		
Member subscriptions transferred to Phytopathology	$1,808.00	
Secretarial work	163.25	
Stationery, stamped envelopes, printing	269.00	
Subscriptions transferred to Phytopathology	5.50	
Postage stamps	23.68	
Supplies, rubber stamps, a/c books, telegrams	8.27	
Expressage on manuscript from Editor-in-Chief	1.14	
Excess dues returned	4.00	
Secretary-Treasurer's travel and miscellaneous expenses	118.47	
Expenses of special committee	58.36	
Check returned by bank	4.25	
Amount transferred to sinking fund for investment	415.58	
Oberly Memorial Fund transferred to Mary K. Bryan	97.33	
		$2,976.83
Balance		$2,001.84
Amount of above receipts for 1924 and 1925	$1,718.65	
Sinking Fund:		
Amount due for 1922	$ 5.00	
Amount due for 1923	35.00	40.00
Amount due Oberly Memorial Fund		3.16
Amount due Phytopathology for Vol. XIII to European Pathologists		44.02
		1,805.83
Actual balance for 1923		$ 196.01

The undersigned committee appointed for this purpose have audited the accounts of The American Phytopathological Society and have found them to be correct.

N. J. Giddings
C. R. Orton

Oberly Memorial Fund:

The request that each member add twenty-five cents to his 1923 annual dues as a personal contribution to the fund for the Eunice R. Oberly Memorial Prize met with a pleasing response. In the Secretary-Treasurer's report for 1922 receipt of $47.48 was acknowledged and since that time $53.01 has been received, making a total of $100.49 contributed by this Society. The committee in charge of this fund informs us that the total amount received from all sources slightly exceeds one thousand dollars. The prize will take the form of a cash award, to the amount of the interest from the fund, to the compiler of the best bibliography for each year in the field of agriculture or the natural sciences.

Membership:

On December 20, 1923, the Society had 557 members in good standing: 90 life sustaining and 467 regular, as opposed to 553 in 1922, 539 in 1921, and 495 in 1920. During the year 25 members were suspended for non-payment of dues and 29 new paid-up members were added, making a net gain of 4. At the Cincinnati meeting 88 new members were elected.

REPORT OF THE BUSINESS MANAGER OF PHYTOPATHOLOGY FOR 1923

STATEMENT OF ACCOUNTS FOR 1923, AS OF DEC. 20, 1923

Receipts:

Balance from 1922			$1,621.28
Member subscriptions transferred from Society			1,808.00
Subscriptions			2,012.80
Sales			398.31
Excess sales			7.50
Advertising, 1921			45.60
Advertising, 1922			182.53
Advertising, 1923			504.77
Interest on invested sinking fund			225.00
Interest on time deposit			4.00
Balance due sinking fund to January 3, 1923			415.58
Time deposit redeposited in checking account			100.00
			$7,325.37

Expenditures:

Manufacturing Phytopathology:			
Vol. XII, No. 10	$240.76		
Vol. XII, No. 11	297.44		
Vol. XII, No. 12	404.06		
Vol. XII, Index	91.41		
		$1,033.67	
Vol. XIII, No. 1	$389.94		
Vol. XIII, No. 2	350.42		
Vol. XIII, No. 3	355.08		
Vol. XIII, No. 4	291.85		
Vol. XIII, No. 5	429.13		
Vol. XIII, No. 6	239.49		
Vol. XIII, No. 7	304.77		
Vol. XIII, No. 8	289.78		
Vol. XIII, No. 9	226.05		
Vol. XIII, No. 10	392.04		
		3,268.55	
		$4,302.22	$4,302.22
Miscellaneous Journal expenses (Dix lists, etc.)			40.85
Second class postage on Phytopathology			45.40
Secretarial work			108.25
Printing billheads			14.00
Postage			10.00

Postage and clerical work for Advertising Manager	4.92	
Excess sales refunded	7.50	
Duplicate subscription refunded	5.00	
Check returned by bank	5.00	
Postage on back volumes sold by C. E. Temple	9.13	
Sinking fund invested with accrued interest	502.73	
		$5,055.00
Balance		$2,270.37
Amount of 1924 subscriptions included in above receipts	319.75	
Actual balance for 1923		$1,950.62

The undersigned committee appointed for this purpose have audited the accounts of Phytopathology and have found them to be correct.

N. J. Giddings,
C. R. Orton

Statement concerning Sinking Fund, as of Dec. 20, 1923

Amount invested in mortgage notes		
McLachlen note (6%)	$ 500.00	
Hobson note No. 1 (6%)	500.00	
Hobson note No. 2 (6%)	1,000.00	
Kaulbeck note No. 1 (7%)	500.00	
Kaulbeck note No. 2 (7%)	500.00	
Phelps note (7%)	500.00	
		$3,500.00
Amount in Phytopathology account due sinking fund		15.58
Amount in Society's account due sinking fund		40.00
		$3,555.58

The statement made in the Business Manager's report of last year that, "The journal of the Society has passed its financial crisis safely and is now on firm ground," is borne out by the experience of 1923. We have printed 562 pages with an index and have come out with an actual balance of six hundred and forty-three dollars in excess of last year. This increase has been due largely to lower manufacturing costs. It should also be noted, however, that one more number of Phytopathology was paid for in 1922 than in 1923, so that the only actual gain for the year is represented by about three hundred dollars.

The income from advertising is an appreciable one and a prospective source of much greater profit. The receipts from advertising in 1920 amounted to $193.93, in 1921—$309.32, in 1922—$519.06, and in 1923—$595.77. This steadily increasing sum is encouraging and leads us to look on advertisements as a promising source of income for use in enlarging and improving *Phytopathology* without calling on the members for further financial assistance. It is hoped that during 1924 a considerable number of new advertisers may be secured, but to do this the assistance of the individual members is necessary. It is manifestly impossible for any one person, such as our advertising manager at Washington, to secure the advertisements of all the concerns that should advertise in *Phytopathology*. Therefore, each member is urged to do what he can to

help in the matter. A half page advertisement for an entire year is almost as good as a sustaining life membership. The following suggestions are offered by Roy G. Pierce, Advertising Manager.

1. That members trade with advertisers, if possible.
2. That you mention *Phytopathology* when ordering from advertisers.
3. That when dealing with concerns you suggest their advertising in *Phytopathology*.
4. That you secure the advertisements of any companies, firms or individuals with which you have particular influence.

For your convenience the advertising rates are given herewith.

Space	For each insertion if type is set	For each additional insertion if copy is not changed	For each insertion if plate is furnished requiring no composition
1 page.....	$15.00	$13.00	$13.00
½ page.....	8.00	7.00	7.00
¼ page.....	5.00	4.50	4.50
⅛ page.....	3.00	2.75	2.75

Inside covers and pages facing reading matter 20 per cent advance.

Back cover page 40 per cent advance.

REPORT OF THE EDITOR-IN-CHIEF OF PHYTOPATHOLOGY

With the end of the present calendar year, the present Editor-in-Chief finishes his three-year term. Because of his resignation at this time it may be well to summarize our operations for the years 1921-23, inclusive.

In the year preceding, namely 1920, 554 pages of text were published. This, however, included 54 pages of the Oberly bibliography of plant pathology, so that the actual amount of other matter was exactly 500 pages.

In 1921, the costs of publication increased greatly and finances were badly strained. An effort was made by the Editor to reduce these costs as far as possible by condensation of papers and elimination of all illustrations which were not absolutely necessary. Nevertheless in 1921 we published 516 pages of text. In 1922, 585 pages, and in 1923, 562 pages were published. It should be said that on December 30, 1920, our publication of the Oberly bibliography was discontinued by vote of the Society, because of a definite understanding with *Botanical Abstracts* that when that publication was thoroughly established it should be the reference publication for us as well as for botanists. It will be noted that the actual pages published in 1923 are slightly more than were published in 1920. Besides the 562 pages of text we have published 23 plates and 98 text figures, approximately the usual number. It should be noted that of the 562 pages of text, 37 pages have been given up to abstracts of the Society and its Divisions.

Beginning with 1921 we have adopted a policy of verifying citations in manuscripts which are submitted for publication. This has been done through the very kind consent and cooperation of the Library of the Bureau of Plant Industry. It has resulted in eliminating many mistakes and has moreover secured for us uniformity in methods of citing. In the same connection it should be said that our moral obligations to *Botanical Abstracts* led to the adoption of what is essentially their method of citing and of printing citations. It seemed best to adopt some definite plan of citation, and it also seemed desirable to have this plan uniform with that of *Botanical Abstracts*.

The Editor would call attention to the increasing patronage of our Journal by foreign workers. This we believe is desirable and should be continued so long as it is feasible, as it must result in increasing interest of foreign workers in our Journal, and in the work which is being done in this country, and must lead to an increased foreign membership and subscription list.

A department of the Journal which is rather neglected at present and which we believe should be used more is the "Phytopathological Notes." As stated above, the Editor's policy during this term has been that of restricting matter published so far as seemed feasible to new investigations and their results. Although the cost of publication has begun to drop, the Editor believes that this policy should be continued.

Because of the absence of the Editor-in-chief in Europe, most of 1922, Dr. L. L. Harter acted as Editor-in-chief for that year, ably carrying on the work under difficult conditions.

REPORT OF THE ADVISORY BOARD

The Advisory Board report was made to the Council by its Chairman, C. R. Orton, and after its approval was referred to the Society and was adopted as follows:

SUMMER CONFERENCES

The fifth annual summer meeting of the Society was held in Western New York and Ontario, Canada, on July 9–12, inclusive, with an attendance of sixty-nine members of the Society and about twenty guests. The program arranged by the Advisory Board was under the direct charge of Dr. M. F. Barrus for New York and Dr. J. H. Faull for Ontario. In Dr. Faull's absence Prof. J. E. Howitt served as chairman *pro tempore* for the Ontario program. Dr. Barrus was ably assisted by H. E. Thomas and W. H. Rankin and Dr. Faull had the assistance of J. E. Howitt and J. F. Hockey in arranging the plans in Ontario. To these men, who so ably arranged and carried out the program for this summer meeting, the Society owes its thanks. A more complete account of the meeting was published in Phytopathology **13:** 507–508. 1923.

PHYTOPATHOLOGICAL INSTITUTE

No further progress has been made on this project which is under the leadership of Dr. E. C. Stakman. The Thompson Institute for Plant Research has initiated studies on the mosaic problem and the Crop Protection Institute has carried on some fundamental studies on sulphur as a fungicide. The further advancement of fundamental researches through institutional agencies should be encouraged but our interest in the projection of an American Institute should be continued.

COMMITTEE ON COOPERATION WITH THE NATIONAL RESEARCH COUNCIL

The Advisory Board through its chairman made a report of its activities to the Division of Biology and Agriculture of the National Research Council at the April meeting of the Division in Washington. It was voted at that meeting to continue the committee on cooperation in phytopathology together with two or three other similar committees. However, since that meeting it has been decided to discontinue this committee on cooperation, as represented by the Advisory Board, but to maintain our contact with the Research Council through our representative, the chairman of the Advisory Board.

SPECIAL RESEARCH AND INVESTIGATIONAL PROJECTS

Rust Project. The Arthur rust project was initiated September 1, 1922, through the joint efforts of the Division of Biology and Agriculture, Office of Cereal Investigations, U. S. D. A.; Indiana Agricultural Experiment Station; the Virginia Polytechnic Institute; the Pennsylvania State College; and the Arthur Committee. Plans for the prosecution of this project were all worked out when Dr. Arthur was taken ill last spring and postponement was necessary. These plans were resumed in November, 1923 when Dr. F. D. Kern spent three weeks at the Indiana Experiment Station assisting Dr. Arthur in the preparation of the book on "Plant Rusts." Dr. F. D. Fromme has arranged to spend the month of January with Dr. Arthur and later in the spring C. R. Orton is expecting to contribute a month to this project. This project should proceed rapidly from now on.

Seed Borne Parasites. Since the last report on this project the committee composed of C. R. Orton, M. F. Barrus and M. T. Munn has prepared a preliminary list of seed borne parasites which has been put in mimeographed form and circulated to leading plant pathologists in the United States and Canada for criticism. Numerous additions were made and the list now totals over 160 with much of the foreign literature untouched.

Further contacts have been made with the American Seed Trade Association and a prospectus for research on the project has been submitted to that Association for consideration by a special committee operated by their President.

The subject was presented to the Canadian Branch of the American Phytopathological Society at their recent meeting at Kingston, Ontario, December 20, by C. R. Orton. Considerable interest is being aroused regarding this project and it is believed that some way will be found soon for initiating researches bearing upon it. The seed analysts are also much interested in the project.

Sulphur Investigations. The sulphur investigations have been continued under the leadership of Dr. B. M. Duggar and Prof. P. J. Parrott and administered by a special committee of the Crop Protection Institute. G. H. Coons and C. R. Orton have continued to serve on this committee. Following the resignation of Dr. H. C. Young, Mr. L. E. Tisdale was appointed to continue the fungicidal investigations which are being continued at the Missouri Botanical Garden. The field tests have been conducted in New York and Pennsylvania during the past season and these will be more fully elaborated next season. The insecticidal phases under the direction of Prof. Parrott are being carried out by Mr. Hartzell. Excellent progress is being made in both phases of the investigations.

Seed Treatment. The seed treatment project under the Crop Protection Institute has been continued under the cooperative plan adopted in 1922. These tests have been carried out with copper carbonate and numerous other disinfectants in many stations in the United States and Canada. Wheat and oats have been the seed used in most cases. Excellent results have been obtained with copper carbonate in practically all cases. The reports are now being received. E. C. Stakman and C. R. Orton have served as the committee on this project.

Furfural Investigations. The Crop Protection Institute has received a fund from the Quaker Oat Company for the purpose of investigating the fungicidal properties of *furfural*, a by-product of their manufacture. This investigation will be conducted at Iowa State College under Dr. I. E. Melhus. The fellowship has not yet been awarded. C. R. Orton has served as Chairman of the committee on this subject.

Scalecide Investigations. These investigations financed by the B. G. Pratt Company under the Crop Protection Institute were started last spring in Massachusetts, Pennsylvania and West Virginia. Mr. J. W. Miller has been conducting the studies which include a study of the effects of Scalecide upon growth and fire blight. C. R. Orton has served as chairman of the committee for the Crop Protection Institute.

CROP PROTECTION INSTITUTE

Coordinative relations have been continued with the Crop Protection Institute, G. H. Coons and C. R. Orton having served during the past year as members of the Board of Governors of the Institute. It appears desirable to continue and to strengthen these relations with the Institute which is growing rapidly and each year filling a more important role in the phytopathological field.

At the Cincinnati meeting M. F. Barrus, the new chairman of the Advisory Board, was chosen as a member of the Board of Governors of the Institute for a term of three years to take the place of F. D. Fromme whose term expired. The other two members of the Board of Governors are C. R. Orton (term expires 1925) and G. H. Coons (term expires 1924).

CROWN GALL REPORT

F. C. Stewart read the report of the committee on crown gall inspection of which he was chairman. It was unanimously adopted and it was voted that the report be published in *Phytopathology* and the official nursery association publications. It was further voted that it was the judgment of the American Phytopathological Society that the committee should be continued and that F. C. Stewart and I. E. Melhus continue to represent the Society on that committee. The report was published in the March, 1924, number of *Phytopathology*.

RESOLUTIONS

A committee on resolutions, composed of E. C. Stakman, J. I. Lauritzen and L. R. Hesler submitted the following resolutions.

1. Dr. John A. Elliott, Plant Pathologist, University of Arkansas, died January 18, 1923.

Dr. M. P. Henderson, Dean of the College of Arts and Science, and Professor Biology, Brigham Young University, died in the late autumn of 1923.

On account of their scientific achievement and personal qualities, they won the professional respect and personal friendship of their colleagues. The American Phytopathological Society records its sense of great loss in the death of these members.

2. *Resolved:* that the American Phytopathological Society endorse the sentiments expressed in the Resolution of the Washington Academy of Science regarding a more liberal policy on the part of the government in paying expenses of scientific men to national and international scientific meetings.

3. The American Phytopathological Society wishes to express its sincere thanks to Mr. C. G. Lloyd for the delightful hospitality which he extended to the members of the Society who visited his museum and library.

4. The American Phytopathological Society wishes to express its appreciation to the University of Cincinnati, especially to the Committee on Local Arrangements for the excellence of the arrangements provided for our meetings; and to the citizens of Cincinnati for their kindness and hospitality during our visit.

MISCELLANEOUS BUSINESS

The secretary's report of the fourteenth annual meeting, held at Boston, was adopted without correction as published in *Phytopathology* 13, April, 1923.

The Society voted to hold its sixteenth annual meeting at Washington, D. C., December 29, 1924 to January 3, 1925 in conjunction with the American Association for the Advancement of Science and other biological societies.

The Society authorized the Council to spend such sums as are feasible and necessary to further the work of the committee on an International Congress. The committee is composed of B. M. Duggar, representing the botanists, H. C. Cowles, representing the ecologists, and H. H. Whetzel, representing the plant pathologists.

On Sunday morning, December 30, 1923 an informal meeting was held at the Hotel Gibson at which the subject of the printing of abstracts and the character of the program at our winter meetings was discussed. A committee, composed of E. C. Stakman, F. D. Fromme, B. T. Dickson, H. H. Whetzel, and R. J. Haskell, selected at that time, brought in the following report which was adopted by the Society at its regular business meeting. It was voted:

1. That the publication of abstracts be continued.

2. That in the near future the Secretary notify each member of the Society that hereafter only those abstracts which embody definite results will be published, and that this statement again be sent in the fall to each member, along with the announcement regarding the submission of abstracts.

3. That the time limit for the receipt of abstracts be November 1.

4. That all abstracts be submitted to an editorial committee of at least three, selected by the chief editor of *Phytopathology*, and that this committee edit the abstracts in the same manner as original articles published in *Phytopathology* are edited.

5. That there be a program committee consisting of the president, secretary, and chairman of the Advisory Board.

6. That the program committee arrange for at least one-half day session for the presentation of special papers on strictly pathological subjects.

7. That arrangements be made for at least some simultaneous sessions held in close proximity to each other in order to provide for informal discussion by smaller groups.

At an informal meeting of the Society at the Gibson Hotel on Sunday evening, December 30, the matter of nomenclature for biological or specialized forms of fungi was discussed. At the conclusion of that session the following motion was passed by those present.

"It is the sense of this meeting that we continue to recognize species on morphologic grounds and that if we recognize varieties in the fungi we recognize them on morphologic grounds; that we designate the entities which are recognized by physiological specialization as physiological races; that we recognize one category of physiological specialization, and that scientific names be not attached to these except where historical precedent or necessity requires."

This motion was read before the Society at its regular business meeting and it was voted that the President select a committee of two to cooperate with other biological societies in these nomenclature problems. C. L. Shear and E. C. Stakman were appointed. W. A. Orton reported progress in the development of the Tropical Research Foundation (formerly designated as the Tropical Phytopathological Institute or Tropical Plant Research Institute). The Foundation has received the approval of the National Research Council. The organization calls for seven trustees, one of

whom shall represent the National Research Council, and another the American Phytopathological Society. The Society chose L. R. Jones as its trustee for a term of five years and designated its Advisory Board as its committee on cooperation with the Tropical Research Foundation. The special committee of the Society and the National Research Council on research in the tropics, of which W. A. Orton is chairman, was continued by vote of the Society.

A communication from Dr. Quanjer of Holland regarding a proposed international phytopathological journal was brought to the attention of the meeting by W. A. Orton. It was voted that a committee of five composed of C. L. Shear, W. A. Orton, Haven Metcalf, F. D. Fromme, and the Editor-in-chief of *Phytopathology* offer to Dr. Quanjer the facilities of *Phytopathology* and take up with him further details concerning the matter.

The Society voted to dispense with the annual summer meeting during 1924 and to encourage the members to go to the meeting of the British Academy of Science at Toronto in August and that the attending botanists be invited to visit our laboratories

One of the Cincinnati radio stations extended the Society an invitation to broadcast information concerning the meetings. This invitation was accepted and L. R. Jones, C. L. Shear, H. H. Whetzel, and W. A. McCubbin were designated to send out the information. The motion was unanimously carried that Miss Mary G. Van Meter, assistant to the Secretary-Treasurer and Business Manager, be given a complimentary membership in the Society for as long a period as she continues in her present position.

R. J. HASKELL, *Secretary.*

The March number of Phytopathology was issued April 12, 1924.